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June 24, 1998

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APPLICATION NUMBER: ***60/048,329***
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60/048329

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THE COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D. C. 20231

Date: June 2, 1997
Atty Docket: FRA971P.APP

Sir:

Transmitted herewith for filing is a **PROVISIONAL** patent application of:

Inventor (1): David Franklin

Address: 9 Preston Road
Somerville, Massachusetts 02143

For: Method and Apparatus for Improving Classroom Amplification Systems

Enclosed are:

X 13 Pages of Specification (Letter Size)

X 3 Sheets of Drawings (Informal)

X Small Entity Declaration

X Assignment Recordation Form; and

X Assignment.

Enclosed is check # 664 in the amount of $75.00 for payment of the filing fee under 37 C.F.R. §116(k) and check # 665 in the amount of $40.00 for payment of the assignment recordation fee.

The Commissioner is hereby authorized to charge payment of any additional fees required for the above-identified application or credit any overpayment to Deposit Account No. 05-0460. A duplicate copy of this sheet is enclosed.

All correspondence regarding this application should be directed to EPSTEIN, EDELL & RETZER at the above address.

Respectfully submitted,

Ira C. Edell
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Hand-delivered: 6/2/97

FRA972P.APP

PATENT APPLICATION

TITLE: METHOD AND APPARATUS FOR IMPROVING CLASSROOM AMPLIFICATION SYSTEMS

INVENTOR: DAVID FRANKLIN

BACKGROUND:

As is well known in the Audiological and Teaching Communities, there are a large number of children in schools who, although classified as having normal hearing, have transient hearing losses due mainly to Otitis Media, or, as it is usually referred to, middle ear infection. For reasons not entirely clear, this kind of infection is increasing in prevalence and has been doing so for at least the past 20 years. The National Center for Health Statistics has developed data that indicates that this affliction, with accompanying mild hearing losses, increased by almost 45% in the period 1981 to 1988 and that the most common cause for doctor visits for children aged 15 or less during the period 1975 through 1990 was Otitis Media, showing an increase of 150% during that study period. For children less than 2, the increase in the same period was 224%. For 1990 alone, the number of children 15 or under reported as having Otitis Media was a staggering 19.8 million according to this same source.

That this trend has in fact resulted in so-called "normally hearing children" in classrooms really being at least to some degree "hearing impaired" has been well documented as well. One such study at a MIDWESTERN suburban school showing typical results found that of 282 children from six kindergarten and six first grades, none of whom were classed as hearing impaired, showed a failure rate when screened for hearing loss according to recommended standards as follows:

* For a screening in the Fall Season------33% failed
* For a screening in the Winter Season----34% failed
* For a screening in the Spring Season----27% failed

Thus at any given time, between 27% and 34% of the class had some degree of hearing loss and, by means of questionnaires filled out by the parents, it was established that these transient hearing losses were directly associated with episodes of Otitis Media.

Other studies of regular classrooms have shown similar results and, even more dramatic, studies in "Special Needs" classrooms have indicated the averages rise to about 75% of the children showing similar transient hearing losses with similar etiologies as causes.

As any pedagogue knows, hearing losses in children, particularly in the earlier grades, leads to poor performance, poor classroom participation and development of poor learning/study skills. It is not a minor problem, but one with extremely serious consequences both for the children with the losses and for society at large. While children with known hearing deficits are usually fitted with hearing aids or so-called "classroom trainers", because of the large numbers of children so afflicted in the group classed as "normally hearing", and because of the transient/floating characteristics of the problem, where at any given time it is not known which children are effected, it is not possible to use the same approach for alleviating the problem as for the much smaller numbers of permanently hearing impaired children.

For all the above reasons, since roughly 1980 a number of researchers have been experimenting with what have come to be called "Classroom Amplification systems". In essence these systems depend on some kind of battery operated transmitter and microphone worn by the teacher, a receiver/audio-amplifier installed in the classroom, and a number of loudspeakers arrayed about the classroom. The simple notion is to amplify the teacher's voice throughout the room so all children have access to it without strain, even if they have mild untreated hearing

losses. The success of the approach has led to a growing number of companies whose major purpose is to design and install such systems nationwide.

There exists one technical issue that in fact has limited the deployment of such systems and that is interference of various types. This problem arises because the main technology being used is radio frequency (RF) transmission to couple the teacher's voice to the receiver. The difficulty is that the reserved band for this kind of hearing assistance system (72 MHZ to 76 MHZ) is subject to interference from a variety of nearby sources such as television stations, CB transmitters, incidental interference from electrical appliances and the like. Other bands such as 49 MHZ, 216 MHZ, 900 MHZ and so on are also used to attempt to obtain better performance but, to date, the interference problem largely has not been solved.

The net result of this difficulty is that seldom more than a few classrooms in any school can have RF amplification systems before serious system functional degradation occurs because of the interference among the adjacent classrooms. Furthermore, that depending on the school location and the equipments surrounding it, systems installed may or may not work well at any given time because of RF sources that move in or out of the vicinity.

DISCLOSURE OF THE INVENTION:

It is the object of the present invention to provide an improved system and method for solving interference problems in classroom amplification systems. More specifically, it is the object of this invention to provide a simple and inexpensive approach, using RF transmitters and receivers from another industry not associated with the hearing impaired, to improve the performance of d classroom amplification systems.

It is observed that the extensive research and development of cordless telephones has resulted in inexpensive, but very sophisticated transmitter/receivers, whose capabilities far exceed those found in even the best RF systems currently being designed for hearing impaired communities.

In particular, I note that the best of the RF receiver/transmitters in the hearing impaired community incorporate at most 10 to 15 channels of analog narrowband FM capability with no special encoding or other means for minimizing the effects of interfering transmitters. I further note that the means for changing from one channel to another to avoid said interference for such receivers is a matter of manually switching both the transmitter and receivers independently of one another. In contrast, it is common for telephone type cordless phones to incorporate a combination of specific digital "handshaking" to assure that each unit in a transmitter/receiver pair only receives messages from the other; that these transmitter/receiver pairs have automatic channel scanning features that enable a user to easily simultaneously change channels with a single key stroke with further assurance that said channel change will be to a "clear" channel, one free of interference; that such telephone cordless systems in many cases include voice scrambling circuitry to assure that even if there is some form of interference, it will appear as noise or garbled speech, such that there is no confusion as to the source; and that further still, such systems even in the lower price and technological range, offer as many as 40 channels or more; and still further, that at the higher end of the cordless telephone technology there are spread-spectrum encoding, digital encoding of other descriptions, frequency agile automatic channel scanning, and as many as 170 channels or more, available to decrease the possibility of interference even further.

DETAILED DESCRIPTION OF CHANGES REQUIRED IN WIRELESS TELEPHONE SYSTEMS TO MAKE THEM SUITABLE FOR USE IN CLASSROOMS:

In recognition of the special requirements of classroom amplification systems, and the somewhat different requirements of cordless telephones, it is clear that some modifications in both the packaging and functional operation of telephone receiver-transmitter equipment is required to make such equipment useful in this new application as a portion of a classroom amplification system. These are as follows:

1. Wherein cordless telephone systems require an alphanumeric keyboard as part of the remote battery operated receiver/transmitter to enable phone dialing, it is preferable that classroom amplification systems have no such keyboard. Hence one modification is the removal of the alphanumeric keyboard by appropriate repackaging of the cordless telephone remote receiver/transmitter. However, it should be recognized that some of the key-functions of the keyboard are still required in this new application. This includes: the "ON" key; the "OFF" key; the "MUTE" key; and "Channel Scan" key. The latter key enables the automatic scan feature which selects a "clear" channel in the event of interference.

2. Wherein the battery operated cordless telephone remote unit requires a built-in microphone, which is presented to the user's mouth when he uses the phone, for the classroom amplification system, a remote microphone is required because the transmitter is usually worn by the teacher clipped to the waist. Such a microphone can easily be supplied by means of a tie-clip microphone, a head-worn microphone, or by a so-called collar microphone; where a jack and appropriate bias voltage and load (if required) can be supplied for the new microphone. Further, while the said remote unit requires an earpiece, in the classroom amplification application, the

remote unit functions only as a transmitter and no earpiece is required. Such deletion can be effected by removal or not of the earpiece and appropriate repackaging.

3. Wherein cordless telephones systems require a base unit, which typically contains the battery charger/management system for the remote receiver/transmitter, this function is likewise required for the aforesaid modified remote unit. However, in the usual telephone application the base unit input connected to the telephone line is configured to sense an "off-hook" current supplied by the telephone company on the phone line when said phone circuit is closed by action of removing the handset and activating its circuit. It is this "off-hook" current that operates a relay thus making the transmitter/receiver circuit active. For operation as part of a classroom amplification system, no such "off-hook" current is supplied, and it is necessary to provide such a source along with an appropriate impedance to enable the system to operate properly. This requirement is easily met with a simple resistor connected to the base unit communication interface (normally to a phone line, but in this new system, to the input to an audio amplifier) where the resistor (typically 100 ohms or so) is connected to a suitable voltage source, typically in the range of 12 volts DC, of either polarity. For the sake of protecting the audio amplifier, it may be necessary to further supply a decoupling capacitor of sufficient magnitude to decouple the 12 volts source from the input of the audio-amplifier, but still pass the desired speech signal.

4. In as much, by law, the telephone bandwidth is limited to the band 300 Hz to 3300 Hz, and it usually is desired, but not mandatory, that classroom amplification systems extend from approximately 200 Hz to above 7 or 8,000 Hz, it is desirable to modify the telephone circuit filtering to accommodate this wider bandwidth. The method for accomplishing this depends on the specific circuits used in the particular telephone unit. An example of one typical phone circuit,

in which a simple modification can be made to the portable transmitter to attain the desired increase in bandwidth is shown in Figure 3 which shows a typical portable transmitter.

BRIEF DESCRIPTION OF DRAWINGS:

These and other aspects of this invention will be made more clear by the following figures in which:

FIGURE 1 diagrammatically illustrates a typical classroom amplification system realized by using a modified portable telephone circuit as aforesaid;

FIGURE 2 schematically illustrates a typical wireless telephone base unit in which, for simplicity, only the portions of the transmitter and receiver relevant to the present invention are illustrated; and

FIGURE 3 schematically illustrates a typical portable receiver phone unit wherein only the portions of the transmitter, receiver and control elements relevant to this new application are shown.

DETAILED DESCRIPTION OF DRAWINGS:

Referring specifically to FIGURE 1, what is shown is a modified remote phone unit 87 in which the alphanumeric keypad is removed, leaving only keys for turn on, turn off, mute and channel scan functions labeled 185, 186, 187 and 183, respectively. In addition it will be appreciated that an internal microphone (not shown) is replaced with an external microphone 151. In operation, a teachers voice is converted into an RF signal and transmitted via antenna 168 through the medium of RF energy 17 such that it is received by the antenna 107 located on the

stationary base unit 82. Base unit 82, in a typical telephone, is normally powered by wall transformer 80 and a second line signal received between terminals T and R on base unit 82. In the present invention, however, where no such power is received at terminals T and R, it is necessary to supply a voltage of approximately plus or minus 12 volts, here labeled as 125, and a load of approximately 100 ohms here shown as resistor 126. This combination of resistor and voltage as indicated serves to operate an internal relay (shown in Figure 2) which in effect "answers the phone", making it operational. The internal circuits in base unit 82 among other operations convert the RF signal into a voice signal which is used as an input to audio power amplifier 47, which in turn drives the room loudspeakers (not shown).

Now, referring to FIGURE 2, a block diagram of base unit 82 indicated in FIGURE 1 is presented, in which: antenna 107 receives the RF signal transmitted by the remote unit 87, which signal contains both audio and digital control signal data. This RF signal now is amplified by RF amplifier 108, down-converted to an IF frequency by mixer 114 and oscillator 115, and thence delivered to the IF detector circuit 117. As part of its operation, detector circuit 117 separates the two portions of the signal into their respective elements; one part being the audio component which is delivered to audio amplifier 119; and the other portion being a digital signal which is delivered to code detector 118. The audio signal is now delivered to block 121, which is labeled as speech network. If, as is now discussed, the combined action of the code detector 118 and the CPU 130 determine that this audio signal is a legitimate one, derived from the proper remote transmitter 87, the audio signal is delivered via the activated "off-hook relay" 123 to the classroom amplification amplifier 147 as indicated.

According to the usual methods employed in modern wireless telephones, the signal delivered to code detector 118 contains three pieces of digital information. The first is a code for the particular frequency being used by the remote transmitter unit. Since the selectivity of this receiver, as determined by the combination of mixer 114, local oscillator 115, and IF detector/narrowband amplifier 117, is very narrow, any RF signal received which results in an output through the tuned IF stage, must be of the proper RF frequency. However, if it is not accompanied by the proper frequency identity code as determined by code detector 118 and CPU 130, the CPU 130 will reject this signal and any derived speechband frequencies by means of its effect on speech network block 121 via an appropriate control signal.

The second code contained in the signal recovered by code detector 118 is a "handshake" code. This code is stored in the remote unit CPU memory whenever the remote unit 87 is placed in its charger 140 which, as indicated, is a part of the base unit 82. In other words, this code is downloaded from CPU 130 to CPU memory 180 (see figure 3) whenever remote unit 87 is being charged by charger 140. If this code does not match, CPU 130, via a control signal to speech network 123, will likewise prevent any audio output from occurring through relay 123.

The third digital code contained in this signal is a descrambling code which is sent to the speech network 121 from CPU 130. The action of the descrambler signal is to decode the speech signal sent from the remote transmitter 87. The purpose of scrambling the speech-band signal is to provide security for normal phone operation. That is, any RF receiver nearby the remote transmitters used to link the remote phone and its base unit cannot be used to listen to a conversation. In the present invention, where security is not a serious consideration, it still plays a valuable role in that if any speech signal is intercepted by the base unit (i.e., an interfering signal

not from the teachers remote unit), it will be acted upon by the descrambler to make it incomprehensible and incapable of being confused with the teachers voice by students.

It is reasonable to ask how, with all these safeguards, any interference can occur for the system. The simple answer is that if a "legitimate" RF signal is being received by base receiver 82 as transmitted by remote transmitter unit 87, then all three code signals required to allow output from relay 123 are present and output will occur. Under these conditions, if an interfering RF signal of the correct frequency is present, it will result in an audio output. Even though this output will generally be scrambled speech or simply noise, it is of course preferable that no such interference be present. Under these conditions, the action of the scan function built into remote transmitter 87 comes into play. In this situation, the user of the remote transmitter unit 87 pushes the channel scan button 183 (see figure 3) which results in a scan code appearing in code detector 118. The combined action of this new code, CPU 130 and speech network 121 progressively changes the frequency of oscillator 115 and looks for a new channel with no speech frequency noise. When this action is completed a new RF frequency code is transmitted to remote unit 87 and a new transmitter frequency is selected for TX oscillator 133, which is transmitted to antenna 107 via RF amplifier 135. When the action is completed, each unit operates on new transmit/receive frequencies.

It should be noted here that the transmit frequency for the remote transmitter and the transmit frequency for the base unit are never the same. Hence, one has (for normal telephone applications) the remote unit "receiver" tuned to the base unit transmitter frequency and the base unit "receiver" tuned to the remote unit transmitter frequency.

Specifically referring to FIGURE 3, what is shown is a microphone 151, typically a head-worn or "tie clip" microphone whose output is amplified by audio-preamplifier 153 and bandpass filtered by filter 154. The resultant speech signal, by action of filter 154 has been limited to the frequency range of approximately 300 Hz to 3300 Hz, as required for telephony, and is now amplified by amplifier 157 and presented to the TX oscillator circuit where it is converted into the appropriate RF frequency for transmission via antenna 168 following amplification by RF amplifier 161. However, in most modern wireless telephones the TX Oscillator will have a second function, under control of the CPU, and that is to "scramble" the voice signal for the reasons discussed above in relation to FIGURE 2. Also, it should be observed that CPU 179 adds the aforesaid digital codes into the audio signal and that these are likewise converted by TX oscillator 160 into the appropriate RF format for transmission along with the converted voice signal. When the composite signal is received by base unit 82, a "handshake" code is transmitted back to remote unit 87 and received via antenna 168, amplified by RF amplifier 170, and converted to a lower IF frequency by the combination of mixer 174 and local oscillator 172. In the present invention for classroom amplification systems, unlike the application as a telephone, this received signal contains only digital encoding data, not speech data, so the portion of FIGURE 3 dealing with this received signal only indicates the signal path for the digital portion.

The said received digital signal is fed to code detector 175 and thence to the CPU 180. If the teacher does not request a new channel (because of interference) by pressing scan button 183 as said previously, and the codes received match those that had been previously downloaded into the remote unit, then the handshake is complete and the teacher's speech is transmitted as previously described. If the teacher does press the scan button the action is also as previously

described. Other teacher actions such as pressing "OFF" button 186 or "Mute" button 187, result in appropriate responses controlled by CPU 179 as shown.

Finally, as stated previously, if it is desired to increase the transmitted bandwidth beyond that specified for telephones, that is to increase it beyond 300 Hz through 3300 Hz as is normally used for the telephone system, bandpass filter 154 can either be bypassed entirely or it can be modified by simple well known means to extend the bandwidth up to that generated by microphone 151 and amplified by preamplifier 153. In some realizations of this typical phone circuit it may be true that there is additional filtering provided in speech network 121 of Figure 2. In this event, it may be required to modify that filter, if it is present, to obtain the desired bandpass response.

SMALL ENTITY DECLARATION

The undersigned declares that the application attached hereto is entitled to the benefit of "small entity" status for paying reduced fees under 35 USC 41(a) and (b) to the Patent and Trademark Office by virtue of the following:

The Business Concern identified below is the owner of all right, title and interest in and to the above-referenced patent application.

I am an official empowered to act on behalf of the Business Concern identified below, which concern qualifies as a small business concern as defined in 37 CFR 1.9(d).

I acknowledge the duty to file, in the subject application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. [37 CFR 1.38(b)]

I hereby declare all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application, any patent issued thereon, or any patent to which this declaration is directed.

Audiological Engineering Corporation
Name of Small Business Concern or Nonprofit Organization

David Franklin — By: D. E. Franklin — 6/2/97
Typed Name — Signature — Date

CEO DF
~~President~~
Title of Signatory

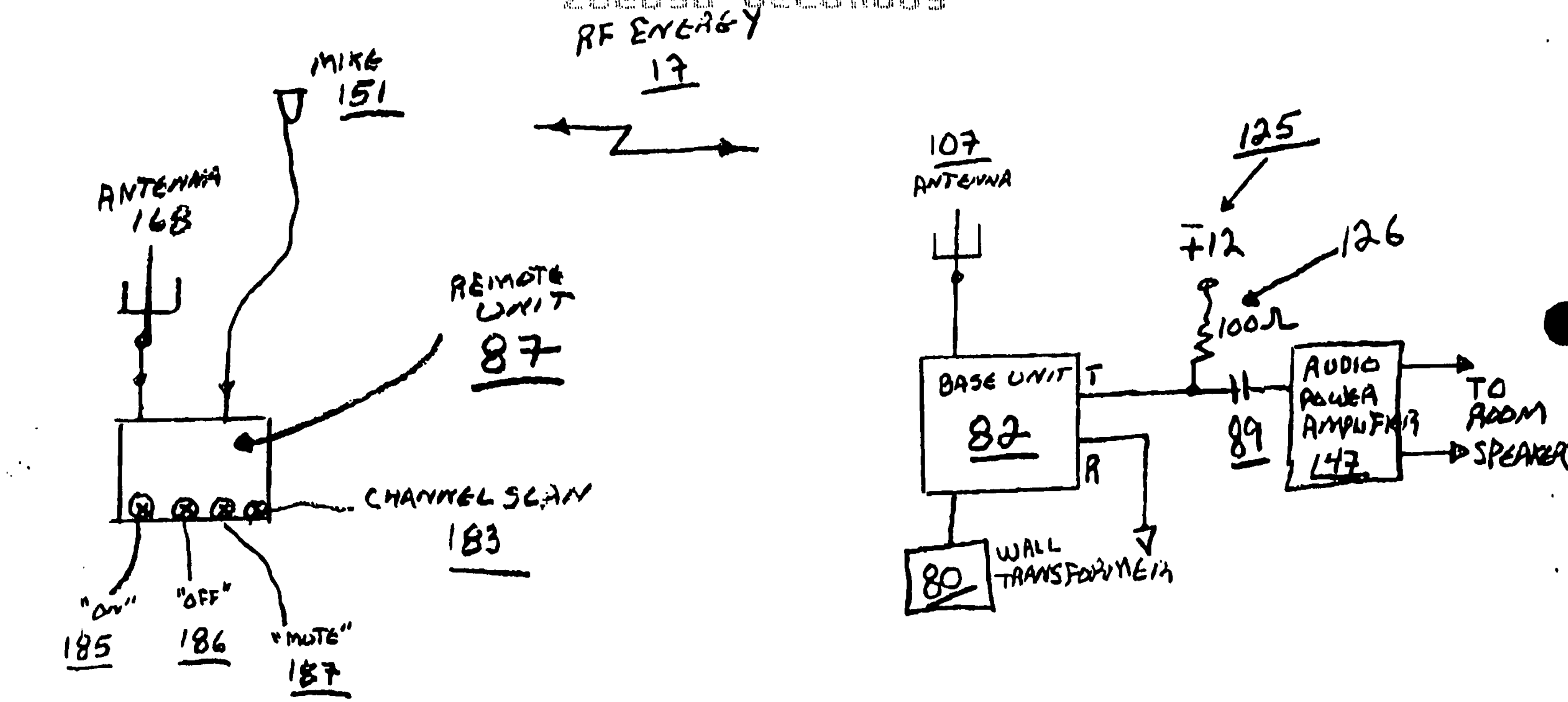

FIG. I. CLASSROOM AMPLIFICATION SYSTEM UTILIZING MODIFIED WIRELESS TELEPHONE

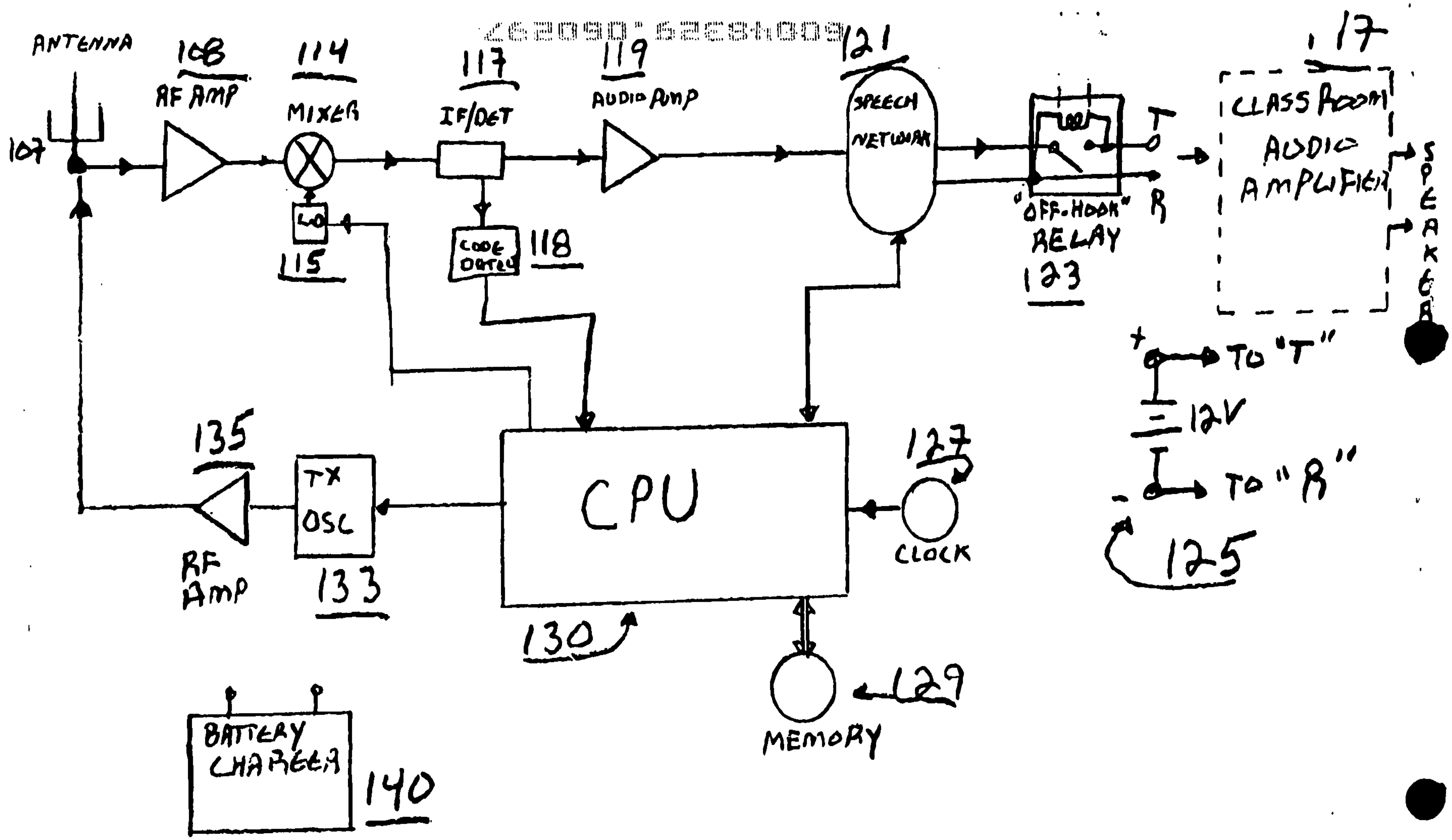

FIG. 2. TYPICAL WIRELESS PHONE – BASE UNIT
RELEVANT PORTIONS

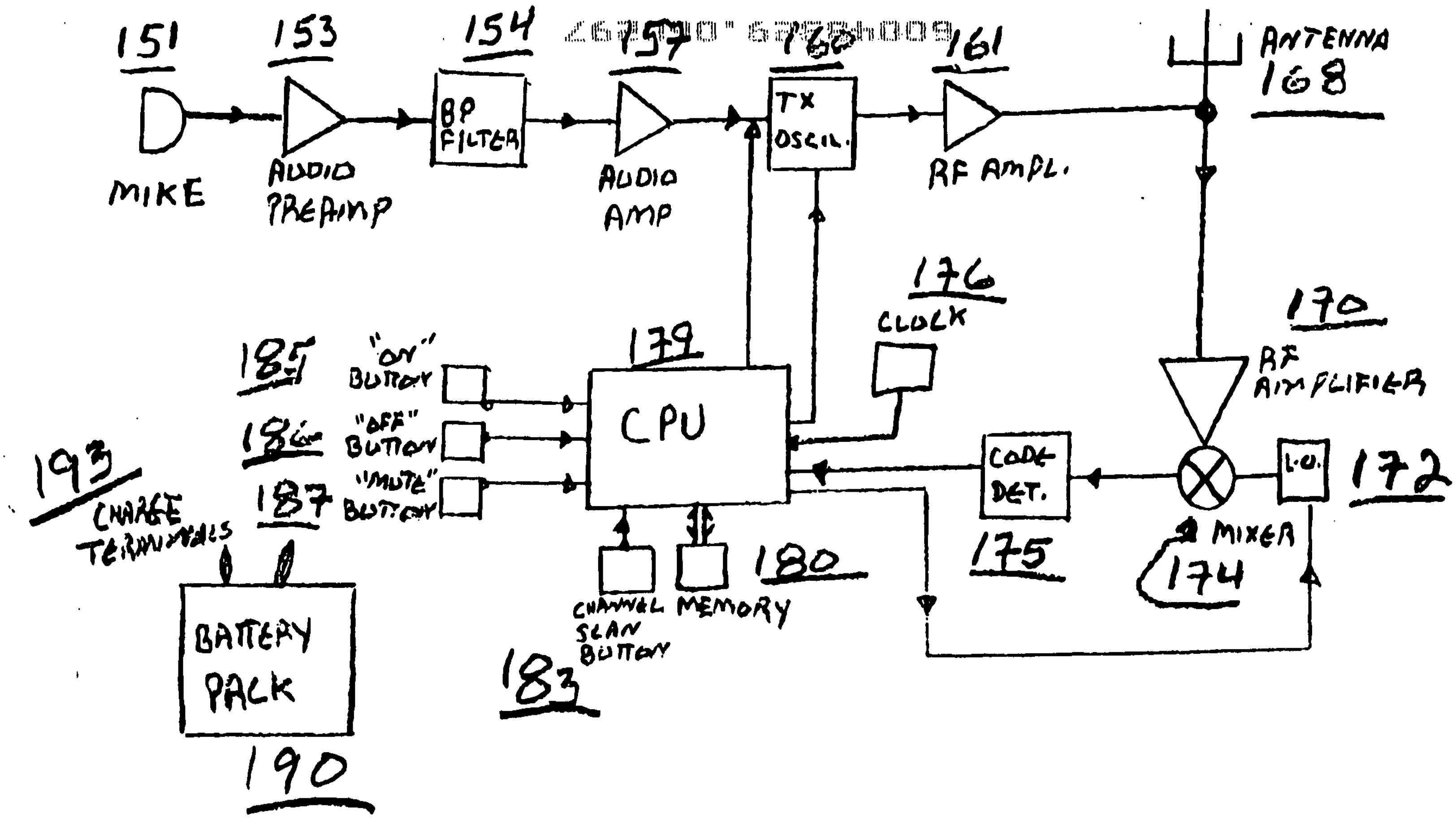

FiG.3 TYPICAL WIRELESS PHONE - PORTABLE UNIT RELEVANT PORTIONS